FLORISTICS OF UPLAND SHORTLEAF PINE/OAK-HICKORY FOREST IN NORTHWESTERN LOUISIANA

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ABSTRACT

The structure of upland shortleaf pine forest and upland shortleaf pine/oak-hickory forest that occurred historically in the Upper West Gulf Coastal Plain is poorly understood. This is primarily because most of it was destroyed before botanists and ecologists were able to describe it. What little is known centers mainly on trees and is derived largely from historical information. The herbaceous layer is even more poorly understood. We describe the herbaceous layer of a shortleaf pine/oak-hickory forest in northwestern Louisiana. The study site is not pristine, but its herbaceous layer may represent what naturally accompanied this type of forest in pre-settlement times.

RESUMEN

La estructura del bosque de pino de hoja corta y bosque de pino de hoja corta /roble-nogal americano que existió históricamente en la zona alta de la llanura costera del West Gulf está poco entendido. Esto se debe en primer lugar a que la mayoría fue destruido antes que los botánicos y ecólogos pudiesen describirlo. Lo poco que se sabe se centra principalmente en los árboles y se deriva mayormente de información histórica. El estrato herbáceo está aún menos conocido. Se describe el estrato herbáceo del bosque de pino de hoja corta / roble-nogal americano en el noroeste de Louisiana. El lugar de estudio no es prístino, pero su estrato herbáceo puede representar lo que de modo natural acompañaba a este tipo de bosque en los tiempos previos a los asentamientos.

INTRODUCTION

Virtually no upland shortleaf pine/oak-hickory forest survived late nineteenth and early twentieth century logging and little is known about this ecosystem, which apparently was once common in the Upper West Gulf Coastal Plain (southern Arkansas, southeastern Oklahoma, northern Louisiana, and northeastern Texas) (Williams & Smith 1995; Carr 2000; Bragg 2002, 2003, 2008; Diggs et al. 2006; MacRoberts & MacRoberts 2008a, 2008b; Masters 2008 and references therein). Historical accounts and photographs indicate that shortleaf pine often dominated and was sometimes found in pure or near pure stands on drier and fire-prone upland sites, but that more often it occurred in association with oak and hickory (Bragg 2002, 2008; Lester et al. 2005). Many stands appeared to be open—"park like"—with a rich "high-light" community of herbaceous plants (Bragg 2002), but like most forest descriptions of the nineteenth and twentieth centuries, the herbaceous layer was ignored and certainly never described in detail (Gilliam 2007). Consequently, not only is little known about the over-story of these forests but even less is known about the herbaceous layer (Carr 2000; Bragg 2002, 2008). The destruction of the shortleaf pine/oak-hickory forest community was so complete, not only through logging but fire suppression and agriculture, that an understanding of this community depends almost entirely on historical documents, notably land survey records and forester's descriptions that emphasize trees (but not always species of trees)(Bragg 2002, 2003, 2004, 2008; MacRoberts & MacRoberts 2005; Nowacki & Abrams 2008; see also Diggs et al. 2006; Van Kley 2006).

In the course of our work on another project on Barksdale Air Force Base, Bossier Parish, in northwestern Louisiana, we found several areas where shortleaf pine was the dominant canopy species, where fire had been used as a management tool, and where the herbaceous layer appeared to be intact.

We took the opportunity to study the flora of one of these sites, recognizing that it was not pristine but that perhaps it was as close to "natural" as now exists. Our main interest was the herbaceous layer. In the few places where shortleaf pine/oak-hickory forest exists, the understory has been radically altered by

fire suppression: fire intolerant and shade-adapted species have replaced the naturally occurring pyrogenic heliophytes (Bragg 2002; Gilliam 2007; Nowacki & Abrams 2008).

STUDY SITE

The study area is located on Barksdale Air Force Base, Bossier Parish, Louisiana, (T17NR12WS2). Natural Areas on Barksdale AFB have been described by McInnis (1997). Land plat records from the 1830s show that the study area was, in general, a pine-oak-hickory forest (McInnis 1997; Lester et al. 2005). While the area has been repeatedly logged, it is still oak-pine-hickory today but is predominantly shortleaf pine. Canopy trees on the study plots today are only shortleaf pine (Fig. 1). In the mid 1990s, the area's pine was thinned from approximately a basal area of 70 to about 45. Removal of pine increased hardwood growth, which was subsequently removed by helicopter application of the herbicide Arsenal. The area is currently controlled burned on a two-to-three year rotation with prescribed fire in the early months (generally January–February) of the year. The area was last burned in February 2008. Soils are the Sacul series, typically moderately well-drained, acid fine sandy loam, thermic Aquic Hapludults, with a clay underlayer along the ridgetops in the uplands (Kilpatrick et al. 1990).

METHODS

To obtain a species list and to determine species richness, we established two 0.1 ha plots, each with two nested 0.001 ha plots and two nested 0.0001 ha plots about 100 m apart on ridge tops (Fig. 1). All species in the plots were recorded and most species in the plots were collected. Voucher specimens are deposited at the Louisiana State University in Shreveport Herbarium LSUS). We visited the site monthly between 2 April 2008 and 21 October 2008.

To determine the geographical distribution of species in the sample, we established a grid of 114 km to a side across the West Gulf Coastal Plain and, using Turner et al. (2003), Thomas and Allen (1993–1998), and USDA NRCS (2008), plotted the distribution of species in the Barksdale AFB shortleaf pine/oak-hickory forest study plots.

Soil samples were collected from the upper 30 cm in the center of each 0.1 ha plot. These were analyzed by the Soil Testing and Plant Analysis Laboratory, Louisiana State University, Baton Rouge.

RESULTS

The flora of the 0.2 ha study area (two 0.1 ha plots) is given in Table 1. Table 2 summarizes the species richness data from the plots. Table 3 gives the soil sample results. Figure 2 gives the results of the geographical distribution analysis.

The two 0.1 ha plots contained 122 species. Taxa from the Asteraceae, Fabaceae, and Poaceae dominated and accounted for 46 percent of the flora. The mean number of species in the two 0.1 ha plots was 99.5 species (92 and 107), the mean number in the four 0.001ha plots was 30.25 species (range 28 to 33) and the mean number in the four 0.0001 ha plots was 17.5 species (range 15 to 19). The soils have low pH (5.2 and 5.4 in two samples) and are generally low in nutrients (see Table 3). The data in Figure 2 indicate that the species found in the study plots are not specific to any particular region of the West Gulf Coastal Plain but occur throughout the area.

DISCUSSION

The Barksdale AFB shortleaf pine/oak-hickory forest flora is remarkably similar to upland longleaf pine forest/savanna in central Louisiana and southeastern Texas (see Harcombe et al. 1993; Van Kley 1999a, 1999b and especially Carr 2000 and references therein). Turner et al. (1999) listed the species groups identified during multivariate analysis to be important in distinguishing among communities in the longleaf pine ecoregion of Texas and Louisiana. These species are abundant enough to occur consistently within a community, but are specialized enough to be present in some communities but absent or markedly less abundant in others. We

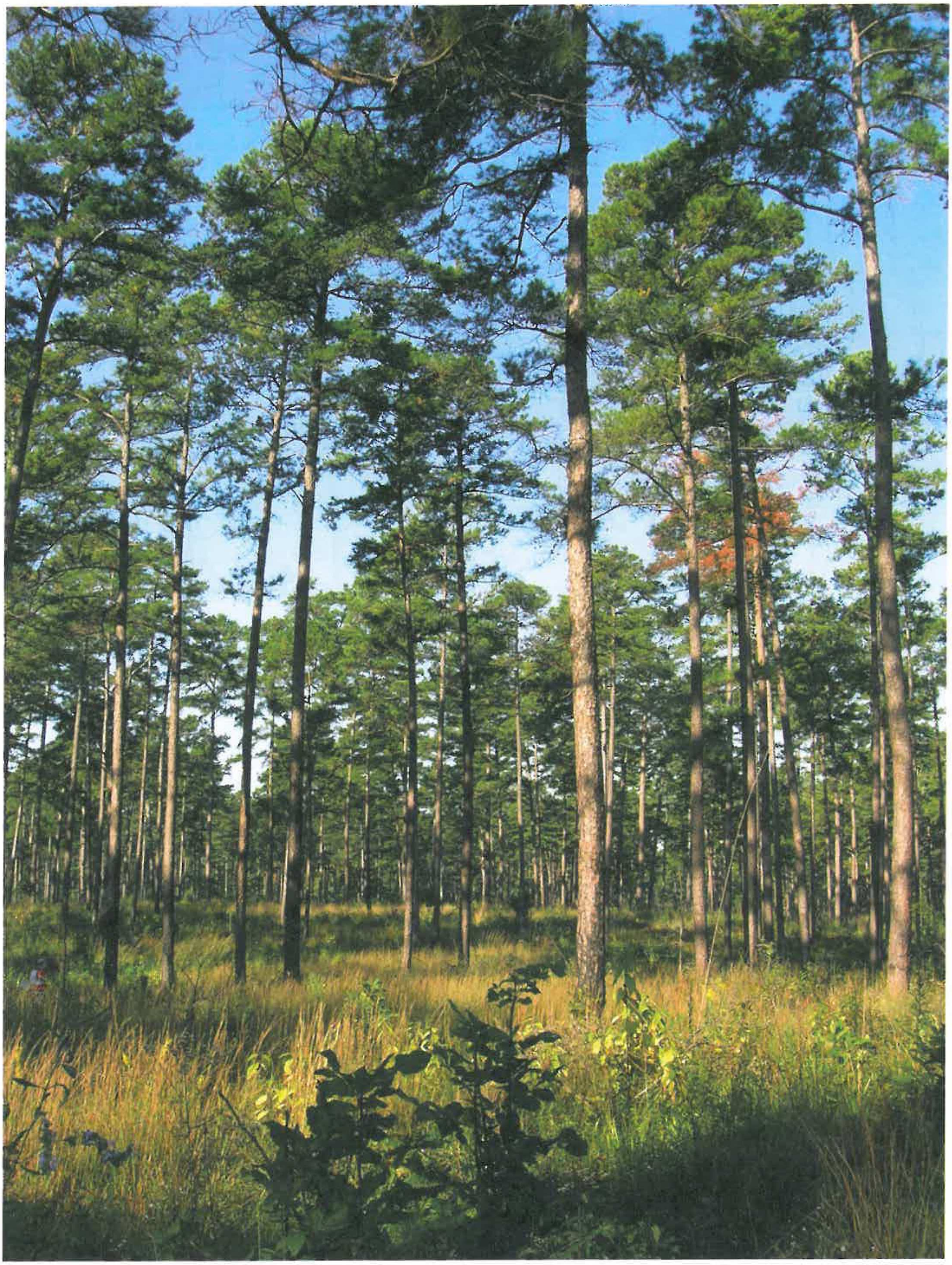

FIG. 1. Barksdale Air Force Base shortleaf pine/oak-hickory forest study site.

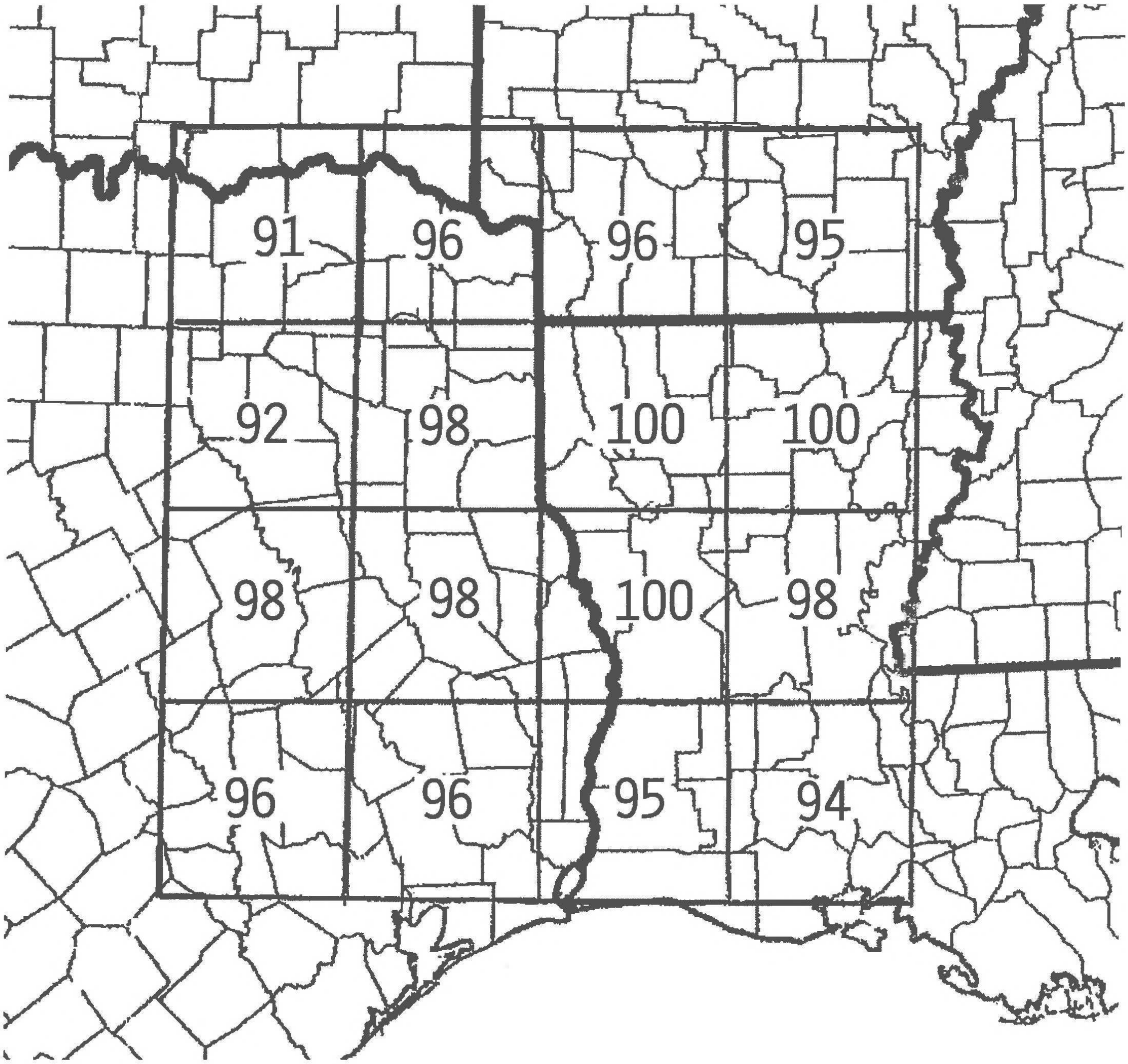

Fig. 2. Percentage of Barksdale AFB shortleaf pine/oak-hickory forest study plot species occurring across the West Gulf Coastal Plain. The grids are 114 km on a side.

found that our shortleaf pine/oak-hickory forest plots had 71 percent of the species in their "Schizachyrium group," which characterizes the upland longleaf pine forest/savanna. This similarity between Barksdale AFB shortleaf pine/oak-hickory forest and particularly upland longleaf pine forest/savanna is reinforced by the plants listed by the Louisiana Natural Heritage Program (2008) as typifying western upland longleaf pine forest: 63 percent occurred in the Barksdale AFB plots. Turning to more detailed studies, 53 percent of the Barksdale AFB shortleaf pine/oak-hickory forest species occur in four 0.1 ha upland longleaf pine forest/savanna plots in central Louisiana on the Kisatchie National Forest (MacRoberts et al. 2002), and 60 percent of the Barksdale AFB shortleaf pine/oak-hickory forest species occurred in eight 0.1 ha upland longleaf pine savanna/forest plots in eastern Texas on the Sabine National Forest (Philipps et al. 2007). An Index of Similarity (Sørensen) between the Barksdale shortleaf pine/oak-hickory forest flora and the flora of upland longleaf pine forest/savanna in both the Kisatchie National Forest in central Louisiana and the Sabine National Forest in eastern Texas (MacRoberts et al. 2002; Philipps et al. 2007) gives figures of 46.4 and 46.5, respectively. Considering the differences in sample size (Barksdale AFB sample, 122 species; Kisatchie

TABLE 1. Species in the two 0.1 ha study plots. Numbers refer to MacRoberts and MacRoberts collections. The lack of a number indicates that a specimen was not collected.

Acanthaceae
Ruellia pedunculata Torr. & A. Gray, 8186
Aceraceae
Acer rubrum L., 8284
Anacardiaceae
Rhus copallinum L., 8316
Toxicodendron radicans (L.) Kuntze
Aristolochiaceae
Aristolochia reticulata Jacq.
Asclepiadaceae
Asclepias variegata L., 8185
Asteraceae
Ambrosia artemisiifolia L., 8295, 8354
Antennaria parlinii Fern., 8146, 8221
Baccharis halimifolia L., 8265
Conyza canadensis (L.) Cronquist, 8340
Coreopsis lanceolata L., 8195
Erigeron strigosus Muhl. ex Willd., 8187
Eupatorium perfoliatum L., 8374
Eupatorium rotundifolium L., 8286
Eurybia hemispherica (Alexander) Nesom, 8338, 8359
Euthamia leptocephala (T. & G.) Greene 8336
Gamochaeta purpurea (L.) Cabrera, 8208, 8222
Helianthus hirsutus Raf., 8262, 8277
Hieracium gronovii L., 8288
Lactuca canadensis L.
Liatris pycnostachya Michx.
Liatris squarrosa (L.) Michx., 8287
Liatris squarrulosa Michx., 8318, 8352
Pityopsis graminifolia (Michx.) Nutt., 8278, 8347
Pseudognaphalium obtusifolium (L.) Hilliard & Burt, 8349
Rudbeckia hirta L., 8270
Solidago altissima L., 8377
Solidago odora Aiton, 8291
Solidago petiolaris Aiton, 8356, 8376
Solidago radula L., 8317, 8357
Solidago rigida L.
Symphytorichum dumosum (L.) Nesom
Symphyotrichum lateriflorum (L.) Á. Löve & D. Löve, 8380
Symphyotrichum patens (Aiton) Nesom, 8209
Verbesina helianthoides Michx., 8194
Vernonia texana (A. Gray) Small, 8271
Campanulaceae
Lobelia appendiculata A. DC., 8193
Triodanis perfoliata (L.) Nieuwl.
Cistaceae
Lechea tenuifolia Michx., 8290
Clusiaceae
Hypericum drummondii (Grev. & Hook.) T. & G., 8355
Hypericum hypericoides (L.) Crantz
Commelinaceae
Commelina erecta L.
Tradescantia hirsutiflora Bush, 8142, 8190
Cyperaceae
Carex complanata Torr. & Hook., 8207, 8211
Cyperus echinatus (L.) Wood, 8202, 8213, 8272
Rhynchospora harveyi W. Boott., 8274
Scleria oligantha Michx., 8203
Dennstedtiaceae
Pteridium aquilinum (L.) Kuhn, 8141
Dioscoreaceae
Dioscorea villosa L., 8137
Ebenaceae
Diospyros virginiana L., 8305, 8298
Ericaceae
Vaccinium arboreum Marshall, 8276
Euphorbiaceae
Acalypha monococca (Engelm. ex A. Gray) L. Mill. & Gandhi, 8282, 8293
Chamaesyce nutans (Laq.) Small, 8341
Euphorbia corollata L., 8145, 8189
Fabaceae
Baptisia nuttalliana Small, 8197
Centrosema virginianum (L.) Benth., 8260, 8321
Crotalaria sagittalis L., 8301
Desmodium ciliare (Muhl. ex Willd.) D.C., 8263, 8280
Lespedeza hirta (L.) Hornem.
Mimosa nuttallii (DC.) B.L. Turner, 8269
Stylosanthes biflora (L.) Britton, Sterns, & Poggenb., 8198
Tephrosia virginiana (L.) Pers., 8279
Vicia caroliniana Walt., 8149
Fagaceae
Quercus falcata Michx., 8373
Quercus marilandica Münchh.
Quercus phellos L., 8292
Quercus stellata Wang., 8372
Hamamelidaceae
Liquidambar styraciflua L., 8266
Iridaceae
Sisyrinchium albidum Raf., 8140
Juglandaceae
Carya sp., 8256
Juncaceae
Juncus dudleyi Wiegand, 8212
Luzula bulbosa (A.W. Wood) Smyth, 8147
Lamiaceae
Monarda fistulosa L., 8267
Salvia azurea Lam., 8356
Salvia lyrata L., 8139
Lauraceae
Sassafras albidum (Nutt.) Nees
Liliaceae
Allium canadense L., 8188
Loganiaceae
Gelsemium sempervirens (L.) St. Hil., 8304
Oleaceae
Chionanthus virginica L., 8296
Oxalidaceae
Oxalis dillenii Jacq., 8191
Oxalis violacea L., 8144, 8210
Pinaceae
Pinus echinata P. Mill., 8281

Table 1. (continued)

Plantaginaceae
Plantago virginica L., 8200
Poaceae
Agrostis hyemalis (Walt.) Britton, Sterns, & Poggenb., 8201, 8218
Andropogon gerardii Vitman, 8315
Andropogon ternarius Michx.
Aristida purpurascens Poir., 8350, 8351, 8375
Chasmanthium sessiliflorum (Poir.) Yates, 8283
Dichanthelium aciculare (Desv. ex Poir.) Gould & Clark, 8217
Dichanthelium dichotomum (L.) Gould, 8204, 8215, 8216
Dichanthelium ravenelii (Scribn. & Merr.) Gould, 8206
Dichanthelium scoparium (Lam.) Gould, 8259
Dichanthelium sphaerocarpon (Elliott) Gould, 8214
Eragrostis spectabilis (Pursh) Steud., 8342, 8344, 8379
Panicum anceps Michx., 8273, 8302
Paspalum setaceum Michx., 8258, 8348
Schizachyrium scoparium (Michx.) Nash
Sphenopholis obtusata (Michx.) Scribn., 8205, 8220
Tridens flavus (L.) Hitch., 8345
Tridens strictus (Nutt.) Nash, 8343, 8346
Polemoniaceae
Phlox pilosa L., 8184
Polygalaceae
Polygala verticillata L., 8199
Portulacaceae
Claytonia virginica L., 8143
Rosaceae
Crataegus spathulata Michx.
Rubus argutus Link
Rubus trivialis Michx., 8306
Rubiaceae
Diodia teres Walter, 8337
Galium obtusum Bigelow, 8196
Galium pilosum Aiton, 8257
Houstonia pusilla Schöepf
Scrophulariaceae
Agalinis tenuifolia (Vahl) Shinners, 8353
Aureolaria grandiflora (Benth.) Pennell, 8335
Pedicularis canadensis L., 8148, 8192
Penstemon laxiflorus Pennell, 8285
Smilacaceae
Smilax bona-nox L.
Smilax glauca Walt., 8261, 8289, 8320
Smilax smallii Morong, 8319
Ulmaceae
Ulmus alata Michx., 8300, 8378
Verbenaceae
Callicarpa americana L., 8268
Violaceae
Viola pedata L., 8138
Vitaceae
Parthenocissus quinquefolia (L.) Planch.
Vitis rotundifolia Michx., 8264

National Forest sample, 158 species; Sabine National Forest sample, 196 species) these figures indicate that all three are probably the same or very similar communities. Van Kley and Welch (2003), in a study using multivariate ordination and classification of 420 sites across the West Gulf Coastal Plain including shortleaf pine/oak-hickory forest and upland longleaf pine forest/savanna, found that plant communities are very similar throughout the region. Carr (2000) found that shortleaf pine/oak-hickory forest resembled pine savanna elsewhere in the southeast United States and pointed out that southeastern pine savanna communities may not be most appropriately defined by dominant overstory species; rather, the hundreds of other plant species present may provide a much better designation of community types. The conclusions of both Carr and Van Kley are reinforced by our finding that none of the species in our shortleaf pine/oak-hickory forest study site is restricted to the Upper West Gulf Coastal Plain.

Other similarities between upland longleaf pine forest/savanna and shortleaf pine/oak-hickory forest are also interesting. The three families that dominate the Barksdale AFB shortleaf pine/oak-hickory forest study area—Asteraceae, Fabaceae, and Poaceae—also dominate the upland longleaf pine forest/savanna in both the Kisatchie National Forest and the Sabine National Forest and account for 43 percent and 42 percent of the flora, respectively (Barksdale AFB shortleaf forest is 46 percent) (MacRoberts et al. 2002; Philipps et al. 2007). Also, shortleaf pine/oak-hickory forest species richness is similar to upland longleaf pine forest/savanna in both the Kisatchie National Forest, which averaged 100 species (range 82–113 species) in four 0.1 ha plots (MacRoberts et al. 2002), and the Sabine National Forest, which averaged 82 species (range 71–112 species) in eight 0.1 ha plots, 29 species (range 17–46) in sixteen 0.001 ha plots, and 12 species (range 5–25) in sixteen 0.0001 ha plots. Finally, the soils in upland longleaf pine forest/savanna and shortleaf pine/oak-hickory forest are similar (MacRoberts et al. 2002).

TABLE 2. Species richness in the two plots.

Plot and plot size (ha)	No. of plots	Mean species (range)
Plot A		
0.0001	2	16.5(15–18)
0.001	2	30.0(30–30)
0.1	1	107.0
Plot B		
0.0001	2	18.5(18–19)
0.001	2	30.5(28–33)
0.1	1	92.0

TABLE 3. Soil sample results for the two plots.

Sample (ppm)	pH	Calcium	Copper	Magnesium	Phosphorous
Plot A	5.35	275.05	0.27	72.80	4.83
Plot B	5.24	222.69	0.20	45.63	25.01

Table 3 continued from right

Sample (ppm)	Potassium	Sodium	Sulfur	Zinc	Soil Texture
Plot A	73.93	5.78	5.26	0.74	sandy loam
Plot B	38.48	4.74	4.86	0.65	fine sandy loam

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